

CAPACITORS

The present invention relates to a capacitors

It is known to have a capacitor made by connecting a plurality of capacitor elements electrically and molding the assembly with synthetic resin. With this type of capacitor in which the capacitor elements are covered by resin, impregnation of resin at the ends of the capacitor elements has to be sufficient. Otherwise, partial discharge will tend to occur, thus causing breakdown of the capacitor. But, it is very difficult or almost impossible to completely impregnate the capacitor elements with synthetic resin at their recessed end portions. Thus, the capacitor elements tend to suffer from corona discharge at their end portions.

With the prior art molded capacitors, this problem is tackled by reducing the voltage assigned to each capacitor element. This increases the number of capacitor elements and makes the capacitor bulky and expensive.

With a prior art molded capacitor, each capacitor element is vacuum-packed in a flexible synthetic resin film

pack and an insulating gas is filled in the film pack. With this type of capacitor, it is relatively easy to vacuum-pack the capacitor elements and then fill the film packs with an insulating gas. But, the insulating gas in the film packs expands or contracts in molding the vacuum-packed capacitor elements with synthetic resin, so that air gaps are liable to develop between the film packs and the molding resin. The air gaps may induce corona discharge. If the film packs are in tight contact with the molding resin and no air gaps develop therebetween, the film packs cannot contract after it has expanded by the temperature rise during molding. This will cause the pressure of the insulating gas in the film packs to drop, thus lowering the corona discharge starting voltage.

An object of the present invention is to provide a capacitor which obviates the abovesaid shortcomings.

In accordance with the present invention, there is provided a capacitor comprising a plurality of inner casings having a shape retaining property; capacitor elements mounted in the respective inner casings; the inner casings being each filled with an insulating fluid and the individually encapsulated with synthetic resin to seal the

insulating fluid therein; the capacitor elements being connected electrically with one another to form an assembly; and an outer casing for containing the assembly with an insulating fluid sealed therein.

Since each of the molded capacitor elements can be tested individually for performance before being connected together, defective elements can be easily picked out before assembly. This will lead to a reduction in the number of defective capacitors.

How the invention may be carried out will be described by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of an embodiment of the capacitor according to the present invention: and

Fig. 2 is an enlarged sectional view of a portion of the same;

The capacitor 1 comprises a plurality of encased and molded capacitor elements 11 connected together electrically with one another.

As shown in Fig. 2, each encased and molded capacitor element 11 comprises a container or casing 4 and a capacitor element 5 housed therein. The casing 4 is filled with an

insulating gas such as SF₆ gas or nitrogen gas and has a glass fiber material 12 wound around its outer periphery.

The capacitor element 11 is manufactured in the following manner.

Firstly a casing 4 is prepared. The casing 4 comprises a body 4a having an open top and a lid 4b closing a top opening of the body 4a. The body 4a and the lid 4b are both made of synthetic resin and formed with holes 7 and 7' for lead wires 6 of the capacitor element 5, respectively. The casing 4 has inner dimensions slightly larger than the outer dimensions of the capacitor element 5 which comprises dielectric layers and electrode layers alternately wound in a spiral-shape. The lid 4b is put on the body 4a so that a gap 8 will be formed therebetween. The gap 8 and gaps 9 formed between the lead wires 6 and the holes 7 and 7' should be large enough to allow the insulating gas to pass into the casing 4 but not so large as to permit the invasion of a highly viscous synthetic resin into the container when the container is molded.

The inner casing 4 should be made of a stiff or rigid material having high heat resistance and insulating and shape-retaining properties, such as polyester resin, polystyrene resin and polycarbonate resin.

After encasing the capacitor element 5 in the body 4a, the lid 4b is put on the body with the lead wires 6 having their ends drawn out of the casing 4 through the holes 7 and 7'.

After the outer surface of the casing 4 has been roughened in the manner which will be described below, the glass fiber material 12 is wound around the outer periphery of the casing 4. The casing is then put in a metal mold and the mold is evacuated. An insulating gas such as SF6 gas or nitrogen gas is admitted into the mold. Then, a highly viscous synthetic resin such as epoxy or urethane resin is poured into between the mold and the casing 4. After the resin has hardened, it is released from the mold.

The casing 4 is thus encapsulated or molded (first molding) in the molding 10 of synthetic resin which serves to fill up the gap 8 between the casing body 4a and the lid 4b and the gaps 9 between the lead wires 6 and the holes 7 and 7' so as to hermetically seal the insulating gas in the casing 4. A numeral 10 indicates a molded layer.

A plurality of molded capacitor elements 11 thus produced are connected in parallel and series with one another and put in a metal mold.

The capacitor elements 11 are housed in a metal casing 13 and an insulating gas such as SF6 gas or nitrogen gas is filled in the casing 13.

The casing 13 comprises a body 13a having its top open and a lid 13b bonded to the body 13a by welding or the like. Bushings 3 are mounted on the lid 13b to connect lead wires 6 from the capacitor elements 11.

With this arrangement, even if the outer casing 13 should lose its gastightness, the inner casings 4 can keep their respective capacitor elements 11 gastight. Since the capacitor elements 5 can thus maintain their high insulating property for a long time and are free from moisture even if the moisture invades the outer casing 13, not only will the reliability of the entire capacitor be greatly improved but also its service life will be extended considerably.

On the other hand, even if the insulating gas in one of the inner casings 4 should leak out, the pressurized insulating gas filling the outer casing 13 will serve to keep the gas pressure in the inner casings 4 from dropping.

This prevents the corona discharge starting voltage from dropping. Further, even if one of the inner casings 4 should lose its gastightness, the outer casing 13 will protect the capacitor elements 5 in the inner casings 4 from moisture. The deterioration of the capacitor will thus be prevented.

An insulating oil may be used instead of an insulating gas.

The casing 4 comprises the body 4a and the lid 4b and is made of polyester, polystyrene or polycarbonate resin. It has such a thickness as not to be deformed by the expansion and contraction during molding.

The casing 4 should preferably have its outer periphery roughened. The roughened surface may be formed by etching or sandblasting or by electrostatically flocking the outer periphery with short fibers of synthetic resin. Its roughness should be set at about 10-100 microns in terms of the difference of

height of high portions or the length of fibers. It is not necessary to roughen the entire outer periphery of the casing 4 but only part of the outer periphery may be roughened where the resin molding is most likely to peel off the casing 4.

Preferably, polyester, polystyrene or polycarbonate resin used for the casing shows good adhesion to epoxy resin so that the casing can be strongly bonded to the resin molding.

CLAIMS:

1. A capacitor comprising a plurality of inner casings having a shape retaining property; capacitor
5 elements mounted in said respective inner casings; said inner casings being each filled with an insulating fluid and individually encapsulated with synthetic resin to seal said insulating fluid therein; said capacitor elements being connected
10 electrically with one another to form an assembly; and an outer casing containing said inner casings and an insulating fluid sealed in said outer casing.

2. A capacitor as claimed in Claim 1 in which the
15 fluid is a gas.

3. A capacitor as claimed in Claim 1 in which the fluid is an oil.

20 4. A capacitor as claimed in any one of Claims 1-3, wherein said inner casing is made of polyester, polystyrene or polycarbonate resin.

5. A capacitor as claimed in any one of Claims 1-4,
25 wherein at least part of the outer periphery of said inner casing is roughened.

6. A capacitor as claimed in any one of Claims 1-5,
30 wherein at least part of the outer periphery of said inner casing is flocked with short fibers.



7. A capacitor as claimed in any one of Claims 1-6, wherein glass fiber material is wound around the outer periphery of said inner casing.

